ORIGINAL ARTICLE

RESEARCHES IN ARTIFICIAL INFESTATION CONDITION AND STORAGE CONDITION OF SOME BEAN CULTIVARS AT BEAN WEEVIL DAMAGE, ACANTHOSCELIDES OBTECTUS SAY

CERCETĂRI ÎN CONDIȚII DE INFESTARE ARTIFICIALĂ ŞI STOCARE ÎN DEPOZIT, A UNUI SORTIMENT DE PROVENIENȚE DE FASOLE, FAȚĂ DE ATACUL GĂRGĂRIȚEI FASOLEI, ACANTHOSCELIDES OBTECTUS SAY

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REZUMAT

Testele efectuate au urmărit posibilitățile de găsire a diverselor proveniențe tolerante la atacul gărgăriței fasolei, *Acanthoscelides obtectus* Say., in condiții de depozit. Infestarea loturilor de semințe s-a făcut artificial în condiții de laborator. Toate proveniențele luate în studiu au fot atacate, dar atacul a fost diferit de la o proveniență la alta. Aceste cultivaruri pot fi utilizate în activitatea de ameliorare a plantelor.

CUVINTE CHEIE: Acanthoscelides obtectus, proveniențe, infestare artificială, depozitare, dăunare

ABSTRACT

Tests were made for finding possible resistant cultivars to the attack of bean weevil, *Acanthoscelides obtectus* Say., in storage condition. The infestation was made artifically in the laboratory condition. All the studied cultivars were attacked, but the attack was significantly different. These cultivars may be employed in the plant breeding activity.

KEY WORDS: *Acanthoscelides obtectus*, bean cultivars, artificial infestation, storage condition, damage

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DETAILED ABSTRACT

The bean weevil, *Acanthoscelides obtectus* Say. is an extremely dangerous pest, if there are no control measures taken, being able to cause damage up to 100% to the stored seeds (CÂNDEA AND BRATU, 1993, MANOLACHE and contributors, 1966).

The studies describe the tolerance of some bean cultivars to the attack from the weevil *A. obtectus.*

The studies presented the injurious effect of the bean weevil *A. obtectus* to the different cultivars.

In 2000 a study was made regarding the response of 7 bean cultivars (Avans, Diva, Vera, Star, Ami, white-spot bean cultivars and red bean cultivars) to the attack of weevil *A. obtectus* under the conditions of infestation in the laboratory and storing in storage conditions for 3 months (10-15ºC; RH = 70-75%).

Investigations made 3 months after storage pursued the determination of some correlations between the main characteristics of the seed and the importance (frequency, intensity) of the pest attack.

The experiment consisted on 7 varieties in 4 repetitions, being organized according to the method of randomized blocks.

All the data gathered from experiments have been statistically construed by variation analysis and Duncan test.

INTRODUCTION

The bean weevil, *A. obtectus* is an extremely dangerous pest, if there are no control measures taken, being able to cause damage up to 100% to the stored seeds.

Given the environment in our country, the bean weevil has 2-3 generations/year. In the warm storehouses the attack is more intense and under these conditions there have been 3-4 generations/year recorded. Studies made in Romania showed that, in order to limit the attack of this pest, besides complying with the quarantine measures, it is recommended to use the tolerant cultivars (MANOLACHE and contributors, 1966, MARGHITU and contributors, 1978, BANITĂ and contributors, GHIZDAVU and contributors, 1999; PORCA and GHIZDAVU, 2001).

The studies describe the tolerance of some bean cultivars to the attack from the weevil *Acanthoscelides obtectus* Say., and this is the most effective link in the integrated control system.

The studies presented the injurious effect of the bean weevil *A. obtectus* to the different cultivars (Porca, 2002).

MATERIALS AND METHODS

The biological material used for infestation has been obtained in growing rooms (thermostat) at a temperature of 28ºC (±2ºC) and 70% RH (±5%). The relative humidity of the air has stated by means of hair hygrometer.

The growing technology consists on placing the insects in polystyrene recipients, on beans with 14-15% RH. These recipients have been equipped with screen cover which allows the gas exchange, and humidity has been ensured on a daily basis by moistening with 2 ml/recipient.

Pocket lens and stereoscopic microscope IOR model have been used for the macroscopic and microscopic study.

In 2000 a study was made regarding the response of 7 bean cultivars to the attack of weevil *A. obtectus* under the conditions of infestation in the laboratory and storing in storage conditions for 3 months (10-15ºC; RH = 70-75%).

The experiment consisted on 7 varieties in 4 repetitions, being organized according to the method of randomized blocks.

All the data gathered from experiments have been statistically construed by variation analysis and Duncan test.

After the distribution of the beans (100 beans/sample) they have been weighed (by means of precision balance KERN 440-33), moistured with 0.5 ml water. These samples have been kept in growing rooms for 3 months, at a temperature of 28ºC and relative air humidity of 75%. Investigations made 3 months after storage pursued the determination of some correlations between the main characteristics of the seed and the importance (frequency, intensity) of the pest attack.

RESULTS AND DISCUTIONS

The response of a range of cultivars in 2000 is presented by estimating the tolerance degree of different cultivars. Two references have been chosen: a) Avans variety and b) the average of the attack on all cultivars. Taken into consideration that the different cultivars demonstrate a considerable variability with regard to tolerance, eventually they resorted to stating, by means of Duncan test, the significance of the differences between different derivations taken by twos.

The experiments pursued the frequency of weevil (*A. obtectus*) attack (%) on different bean derivations (tables 1 and 2), the intensity of the attack (tables 3 and 4) and the total loss of biomass/bean caused by the weevil attack on different bean cultivars (tables 5 and 6) (PORCA and GHIZDAVU, 2001).

The analysis of the data in table 1 shows that the highest frequency of the attack was recorded at red bean cultivars (F% = 47.50%) followed, in decreasing order, by Ami variety (47.25%), white-spot bean cultivars (47.00%), Star (25.00%), Diva (23.75%) and Vera (20.25%). The least intensely attacked variety was Avans with F%= 14.50%.

Table 1: The frequency of the bean weevil (*Acanthoscelides obtectus Say)* attack on different bean varieties, (Cluj-Napoca, 2000)

	Variants	Attac frequency (%) in control Mt_1		± d	Signif. of difference in control Mt_1	Attac frequency (%) in control Mt_2		± d	Signif. of difference in control Mt_2
		Absolute values	Relative values			Absolute values	Relative values		
1.	Avans (Mt_1)	14.50	100.00	+0.00	-	14.50	44.30	-18.25	000
2.	Diva	23.75	163.79	+9.25	***	23.75	72.50	-9.00	000
3.	Vera	20.25	139.65	+5.75	***	20.25	61.80	-12.50	000
4.	Star	25.00	172.41	+10.50	***	25.00	76.30	-7.75	000
5.	Ami	47.25	325.86	+32.75	***	47.25	144.30	+14.50	***
6.	White-spot bean cultivars	47.00	324.00	+32.50	***	47.00	143.50	+14.25	***
7.	Red bean cultivars	47.50	327.58	+33.00	***	47.50	145.00	+14.75	***
8.	Varians means (Mt_2)					32.75	100.00	+0.00	-
				$DL_{5\%}$ =	1.70				1.70
				$DL_{1\%}$ =	2.44				2.44
				$DL_{0.1\%}$ =	3.45				3.45

By comparing the differences between the frequencies of the attack recorded at different varieties and Mt_1 (Avans variety), it can be noticed that the varieties have been more intensely attacked (+33.0, +5.75) the differences being very significantly positive.

By comparing the differences between the frequencies of the attack recorded at different derivations and Mt_2 (average of varieties), it can be noticed that the following varieties have been more intensely attacked, these statistically assured differences being very significant positive: red bean cultivars (145.00%, +14.75), Ami variety (144.30%, +14.50), white-spot bean cultivars (143.50%, +14.25).

The following varieties were less intensely attacked: Star (76.30%, -7.75), Diva (72.50%, -9.0), Vera (61.80%, -12.50) and Avans (44.30%, -18.25), with relatively substantial difference in comparison with the average of varieties (Mt_2), these substantial differences being very significant negative.

Table 2: The significance of differences in attack frequency between the pairs of varieties which have been studied (Duncan test) (Cluj-Napoca, 2000)

Clasification	Variants	F %	significance of differences between pairs of varieties					
			II	III	IV	V	VI	VII
I	Red bean cultivars	47.50	0.25 (1.72)	0.50 (1.80)	22.5 * (1.85)	23.75 * (1.88)	27.25* (1.90)	33.0 * (1.92)
II	Ami	47.25	-	0.25 (1.72)	22.25 * (1.80)	23.5 * (1.85)	27.00 * (1.88)	* (1.90)
III	White-spot bean cultivars	47.00		-	22.00 * (1.72)	23.25 * (1.80)	26.75 * (1.85)	32.50 * (1.88)
IV	Star	25.00			-	1.25 (1.72)	4.75 * (1.80)	10.5 * (1.85)
V	Diva	23.75				-	3.50 * (1.72)	9.25 * (1.80)
VI	Vera	20.25					-	5.75 * (1.72)
VII	Avans	14.50						-

The conclusion is that the lowest frequency of the attack has been recorded at Avans variety (F% = 14.50 %), followed by Vera variety (20.25%), Diva (23.75%) and Star (25.00%).
The significance of differences between pairs of varieties is synthetically presented in table 2. In this table the varieties are arranged in decreasing order, starting with the most intensely attacked, red bean cultivars (F% = 47.50%), to the less intensely attacked, Avans (14.50%).
From the data analysis it can be noticed that the differences between varieties are statistically assured at DL 5% degree, which means that the material that has been studied is quite heterogeneous from the point of view of tolerance, and there are rather consistent differences between the varieties which have been studied. The only case of non-significant difference is between varieties I-II, I-III, II-III and IV-V.

Data referring to the intensity of the attack on different varieties tested in 2000 are offered in table 3.

Table 3: The attack intensity on bean weevil (*Acanthoscelides obtectus* Say) of different bean sources (Cluj-Napoca, 2000)

	Variants	Attac intensity (%) in control Mt_1		± d	Signif. of difference in control Mt_1	Attac intensity (%) in control Mt_2		± d	Signif. of difference in control Mt_2
		Absolute values	Relative values			Absolute values	Relative values		
1.	Avans (Mt_1)	2.15	100.00	+0.00	-	2.15	86.70	-0.33	000
2.	Diva	2.26	105.11	+0.11	***	2.26	91.20	-0.22	000
3.	Vera	2.07	96.27	-0.08	00	2.07	83.50	-0.41	000
4.	Star	1.96	91.16	-0.19	000	1.96	79.10	-0.52	000
5.	Ami	2.92	135.81	+0.77	***	2.92	117.80	+0.44	***
6.	Red bean cultivars	3.15	146.51	+1.00	***	3.15	127.10	+0.67	***
7.	White-spot bean cultivars	2.83	131.62	+0.68	***	2.83	114.30	+0.35	***
8.	Varians means (Mt_2)					2.48	100.00	+0.00	-
					$DL_{5\%}$ = 0.043				0.043
					$DL_{1\%}$ = 0.061				0.061
					$DL_{0.1\%}$ = 0.086				0.086

By analysing table 3 it can be noticed that the most intensely attacked variety is red bean cultivars (I = 3.15 opercula/bean), followed, in decreasing order, by Ami (2.92), White-spot bean cultivars (2.83), Diva (2.26), Avans (2.15) and Vera (2.07).

The least intensely attacked was Star variety with I = 1.96 opercula/bean.

By comparing the differences between the intensities of the attack recorded at different varieties and Mt_1 (Avans variety), it can be noticed that following varieties have been more intensely attacked: red bean cultivars (146.51%, +1.00), Ami variety (135.81%, +0.77), white-spot bean cultivars (131.62%, +0.68) and Diva variety (105.11%, +0.11), the differences are very significant positive.

By comparing the differences between the intensities of the attack recorded at different varieties and the average of varieties (Mt_2), it can be noticed that, in comparison with this reference, red bean cultivars (I=127.10%, +0.67), Ami variety (117.80%, +0.44) and white-spot bean cultivars (114.30%, +0.35), were more intensely attacked the differences statistically assured being very significant positive.

The less intensely attacked were: Diva (-0.22), Avans (-0.33), Vera (-0.41) and Star (-0.52), varieties with relatively substantial differences in comparison with the average of varieties (Mt_2). These substantial differences are statistically assured to Mt_2 with very significant negative significance degree.

The conclusion is that from the point of view of attack the most valuable variety was Star (I= 1.96 opercula/seed), followed by Vera (2.07), Avans (2.15) and Diva (2.26).

The significance of differences in attack intensity between the varieties tested in 2000, determined by means of Duncan test, is presented in table 4.

In this table the varieties are listed in decreasing order, starting with the most intensely attacked, red bean cultivars (3.15 opercula/bean) to the least intensely attacked, Star (1.96 opercula/bean). From the data analysis it can be noticed that, with few exceptions, the differences between varieties are statistically assured at DL 5% level, which means that the material that has been studied is quite heterogeneous from the point of view of tolerance.

Table 4: The significance of differences in attack intensity between the pairs of varieties which have been studied (Duncan test) (Cluj-Napoca, 2000)

Clasification	Variants	(I)	significance of differences between pairs of varieties					
			II	III	IV	V	VI	VII
I	Red bean cultivars	3.15	0.23 * (0.04)	0.32 * (0.04)	0.89 * (0.04)	1.00 * (0.04)	* (0.04)	1.19 * (0.04)
II	Ami	2.92	-	0.09 * (0.04)	0.66 * (0.04)	0.77 * (0.04)	0.85 * (0.04)	0.96* (0.04)
III	White-spot bean cultivars	2.83		-	0.57 * (0.04)	0.68 * (0.04)	0.76 * (0.04)	0.87 * (0.04)
IV	Diva	2.26			-	0.11 * (0.04)	0.19 * (0.04)	0.3 * (0.04)
V	Avans	2.15				-	0.08 * (0.04)	0.19 * (0.04)
VI	Vera	2.07					-	0.11 * (0.04)
VII	Star	1.96						-

The data regarding the total losses of weight/bean caused by the attack of bean weevil *A. obtectus* are presented in tables 5 and 6. From the data analysis in table 5 it can be noticed that the most substantial losses/bean have been recorded at red bean cultivars, P% = 12.84%, followed, in decreasing order, by white-spot bean cultivars (12.18%), Ami variety (11.02%), Vera (8.46%), Star (8.08%) and Diva (7.44%). The lowest loss/bean has been recorded at Avans variety (3.65%).

Table 5: The total losses of weight/bean caused by the attack of bean weevil *Acanthoscelides obtectus Say* of different bean variety, (Cluj-Napoca, 2000)

	Variants	Total losses (%) in control Mt_1		± d	Signif. of difference in control Mt_1	Total losses (%) in control Mt_2		± d	Signif. of difference in control Mt_2
		Absolute values	Relative values			Absolute values	Relative values		
	Avans (Mt_1)	3.56	100.00	+0.00	-	3.56	38.90	-5.59	000
2.	Diva	7.44	208.90	+3.88	***	7.44	81.30	-1.71	000
3.	Vera	8.46	237.00	+4.90	***	8.46	92.40	-0.69	00
4.	Star	8.08	226.90	+4.52	***	8.08	88.30	-1.07	000
5.	Ami	11.02	309.50	+7.46	***	11.02	120.40	+1.87	***
6.	White-spot bean cultivars	12.84	360.60	+9.28	***	12.18	140.30	+3.69	***
7.	Red bean cultivars	12.18	342.10	+8.62	***	12.84	133.10	+3.03	***
8.	Variants means (Mt_2)					9.15	100.0	+0.00	-
					$DL_{5\%}$ = 0.41				0.41
					$DL_{1\%}$ = 0.58				0.58
					$DL_{0.1\%}$ = 0.82				0.82

By comparing the differences between the losses at different varieties and Mt_1 (Avans variety), it can be noticed that the most substantial losses have been recorded at the all varieties: Diva: 208.9% and red bean cultivars: 360.6%) and the differences (from +3.88 at +9.28) being very significant positive.

By analysing the data regarding differences of varieties which have been studied, in comparison with Mt_2 (average of varieties), it can be noticed that from this reference the more intensely attacked varieties are: Ami variety (120.4%, +1.87), white-spot bean cultivars (133.1%, +3.03) and red bean cultivars (140.3%, +3.69), the differences being statistically assured at the very significant positive significance degree.

The lowest losses have been recorded at the following varieties: Diva (81.30%, -1.71), Star (88.30%, -1.07) and Avans (38.90%, -5.59), with relatively substantial differences in comparison with Mt_2, statistically assured at the very significant negative significance degree.

We conclude that the most insignificant losses/bean have been recorded at Avans variety (3.56%) .

The significance of differences between pairs of cultivars from the point of view of biomass losses/bean, is presented in table 6.

In this table, the varieties are listed in decreasing order starting with the one which has the most substantial loss/bean, red bean cultivars (12.84%), to the one which has the most insignificant loss/bean, Avans (3.56%).

From the data analysis it can be noticed that the differences between varieties are statistically assured at DL 5% level, which means that the material that has been studied is quite heterogeneous from the point of view of tolerance. The case of non-significant difference is between varieties IV-V.

Table 6: The significance of differences in total losses/ weight/bean between the pairs of varieties which have been studied (Duncan test) (Cluj-Napoca, 2000)

Clasification	Variants	P %/ seed	significance of differences between pairs of varieties					
			II	III	IV	V	VI	VII
I	Red bean cultivars	12.84	0.66 * (0.58)	1.82 * (0.61)	4.38 * (0.62)	4.76 * (0.64)	5.40 * (0.64)	9.28 * (0.65)
II	White-spot bean cultivars	12.18	-	1.16 * (0.58)	3.72 * (0.61)	4.10 * (0.62)	4.74 * (0.64)	8.64 * (0.64)
III	Ami	11.02		-	2.56 * (0.58)	2.94 * (0.61)	3.58 * (0.62)	7.46 * (0.64)
IV	Vera	8.46			-	0.38 (0.58)	1.02 * (0.61)	4.90 * (0.62)
V	Star	8.08				-	0.64 * (0.58)	4.52 * (0.61)
VI	Diva	7.44					-	3.88 * (0.58)
VII	Avans	3.56						-

CONCLUSIONS

The lowest frequence of the attack has been recorded at Avans variety (F% = 14.50), followed, in ascending order, by Vera (20.25%), Diva (23.75%), Star (25.00%), white spot bean cultivars (47.00%) and Ami (47.25%). The most violently attacked was red ben cultivars (47.50%).

The lowest intensity of attack has been recorded at Star variety (I = 1.96 opercula/bean) followed by Vera variety (2.07) and, in ascending order: Avans (2.15), Diva (2.26), white spot bean cultivars (2.83), and Ami (2.92) and the most intensely attack was recorded at the red bean cultivars (3.15).

The lowest loss of total biomass/bean has been recorded at Avans variety (L = 3.56%), followed by Diva (7.44%), Star (8.08%), Vera (8.46%), Ami (11.02%) and white spot bean cultivars (12.18%). The most significant loss of biomass/bean has been recorded at the red bean cultivars (12.84%).

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